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It is proposed to issue Volume VIII of *The Journal of General Physiology* as a memorial to its founder, Dr. Jacques Loeb. This volume will contain papers by Dr. Loeb's pupils and his associates, together with a portrait and a sketch of his life. The volume will appear simultaneously with Volume IX, and publication will commence September 18, 1925.

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THE APPEAL OF SCIENCE TO THE COMMUNITY

THE subject on which I shall venture to speak to you this evening is one which some of you, perhaps, may deem too threadbare for further consideration. The position which science holds or ought to hold among the general interests of the community has formed the theme of many an eloquent and vigorous address, and leaders among the men of science in this and other English-speaking countries have time and again urged its claims upon an apparently or supposedly slothful and perverse generation. If I then venture once more to speak on this topic it is because there are abundant evidences that the past few years have been a time of awakening and awakened interest in science, and that it is our duty to do our utmost to guide and quicken this interest. Has not the well-known Scottish writer, Sir James Barrie, borne testimony that "the man of science appears to be the only man who has something to say just now," although he somewhat unkindly adds the opinion that he is the only man who does not know how to say it? Although a great change has, I believe, taken place in public opinion, in this as well as in my own country, regarding the work of science, there nevertheless exists the necessity of urging, with persistence but also with restraint, the great importance of cultivating what we may call the scientific habit of mind and of securing the right and proper appreciation of the value of creative scientific work. We can not, therefore, consider too carefully or too frequently how, in a spirit of service, we may best frame our appeal to the community and bring to our fellow men a knowledge and appreciation of those benefits and delights which come from a study of nature.

The ground on which the appeal of science has been most frequently and, perhaps, most noisily made has been that of the utility of science, not merely in the practical business of life and of earning one's livelihood, but also in the preservation of life itself and in the provision of physical comfort. "Real gain, real progress," as the late Sir William Ramsay declared, "consists in learning how better to employ energy, how better to effect its transformation," and, looking back over the history, more especially of the nineteenth and twentieth centuries, down to the present day, it is easy to mark how great have been the achievements of science in this direction. One thinks, for example, of the develop-

ment of the steam engine, the gas engine, the internal combustion engine; of the development of the electric dynamo and the utilization of electrical energy; of the conversion of the energy of falling water into electrical and other forms of energy; of the development of machinery of all kinds; of the concentration of chemical energy, as in explosives, and so on. And in the domain of biological science and of preventive medicine the achievements have been no less remarkable. It is the biologist and bacteriologist who have made Central Africa, for example, safe for man's habitation, and it is no exaggeration to say that the Panama Canal was built not by the engineer but by the biologist. It is the man of science who, through his influence on industrial and agricultural development and the development of natural resources, determines what population a country can support. It is the man of science, indeed, who in the last resort decides the economic fate of nations.

It was Pasteur who claimed that "in our century science is the soul of the prosperity of nations and the living source of all progress. What really leads us forward are a few scientific discoveries and their applications." And these claims can, indeed, be substantiated by the work of Pasteur himself.

In the middle of last century, as you all know, the silk cultivation of France, of Spain and of Italy was threatened with extinction. In 1849, a disease, called *pébrine,* attacked the silkworms of France and in the short space of twelve years, we are told, "the mulberry plantations on the slopes of the Cevennes mountains, which had for long given employment to a happy and contented people, were completely abandoned, and the once radiant faces of men became sad and melancholy because misery and poverty prevailed where before happiness and plenty had reigned." In the same space of time, also, the annual revenue derived by the state from the silk industries fell from 130,000,000 to 8,000,000 francs. From the bankruptcy with which it was faced, the silk industry was saved by the scientific labors of Pasteur. It is to Pasteur, also, that much of the present-day prosperity of the various fermentation industries is due; it is to Pasteur that we owe our earliest knowledge of the bacterial origin of disease and the production of immunity by vaccines which led to the culminating glory of Pasteur's life, the cure of rabies or hydrophobia. It is, moreover, on the foundations of Pasteur's work that the practice of antiseptic surgery was built up, whereby the havoc and torture of festering sores and gangrenous wounds were abolished from the surgical wards of our hospitals. What a glorious life of service to humanity for a single man to achieve! How irresistible must seem this appeal of science! And the people not only of France but of other countries as well answered the appeal and erected the Institut Pasteur as a tribute to the genius of Pasteur and in recognition of the services which science through him had rendered to mankind. The appeal in this case went home because it was centered in a living person whose "science" could be generally understood and whose unselfish work touched the heart and humanity of man. In contrast with the success of that appeal stands the comparative failure of the more general appeal for the support of the science laboratories of France which was made two years ago on the occasion of the national celebration of the hundredth anniversary of Pasteur's birth. The appeal in this case was too general; it awakened small response because the people could not understand its meaning. From this we learn that even the utilitarian appeal of science will arouse a general response only in so far as it is interpreted to the community in terms which the people can individually understand.

And this has been found to be the case, also, with regard to the utility of science in its applications in industry. The different countries of the modern world, and especially the older countries, are becoming more and more industrialized, and however much we may sometimes deplore the fact we must recognize that only by this means can the ever-growing populations of these countries be supported. As the populations grow and as the conditions of life become, through competition, more and more strenuous and exacting, the necessity arises for ever-increasing efficiency in the industries and in the utilization of the natural resources of the country. It is only natural, therefore, that men of science, in a spirit of helpfulness and in the consciousness of their knowledge, should have urged the vital necessity of a wider and fuller application of scientific knowledge and scientific method, for by that means alone was it possible to enlarge the scope of the industries and to increase their efficiency. For a long time the appeal bore little fruit in my own country, and, as I gather, not very much even in this. In this country, the enormous, the apparently almost inexhaustible natural resources of the country, the great and rapidly expanding home market and the absence of any serious competition from outside made it difficult for people to realize the wisdom if not the actual necessity for avoidance of waste and for the application of science in industry. And in England the industries on which, early last century, the country grew wealthy were such that their dependence on science was not very obvious and so, owing to a natural inertia of mind and a fairly widespread prosperity, the necessity of applying more scientific methods with a view to diminishing waste and improving

production, and for the purpose, also, of establishing new industries never entered very fully into the tissues of the people's minds. We prided ourselves on being a practical people; abstract learning and knowledge were held in comparatively slight esteem; the investigations of men of science made little appeal to us, for the people did not understand them; the people, indeed, had not been educated so as to be able to understand them. While it is easy to place on the manufacturers the responsibility of a general backwardness in applying the discoveries of science to industry, it must be confessed that the teachers of science were not wholly free from blame for failing to enter more fully into the difficulties of the manufacturers and for failing to keep in touch with the industrial and practical life of the country and to show more clearly and convincingly the relation between their own sometimes abstract work in pure science and the practical everyday life of the community.

If, however, the appeals of science remained largely unheeded in times of prosperity they had perforce to be responded to in the adversity of war. The highest efficiency of manufacture was necessary if the country was to succeed: men of the widest scientific sympathies and of highest eminence in creative science became the directors and controllers of industry, and the least efficient factory had to be brought to the level of the most efficient. It was the demonstration of the increased efficiency produced by scientific control that made the utilitarian appeal of science carry conviction to the manufacturers, which interpreted to the mind of the layman and of the statesman the true relation between the discoveries of pure science and their applications in industry. As a result of the lessons learned during the war, the government of Great Britain in 1919 appropriated the sum of £1,000,000 for the encouragement of scientific and industrial research. Manufacturers were encouraged to group themselves according to their industries and to establish, with the help of government grants, research institutes where the discoveries of science could be focussed and investigations carried out on the problems of each particular industry. Government assistance was promised for a period of five years, after which time it was hoped the research institutes would have become sufficiently firmly established and would have proved their value so that the industries themselves would assume the whole burden of their maintenance. Upwards of twenty research institutes have been thus established, and they have proved themselves of the greatest value to the industries. The Department of Scientific and Industrial Research, also, instituted or supported the investigation of problems of national importance, such as the economical utilization of coal, including the methods of low temperature carbonization for the supply of a readily burning coke and of a fuel suitable for internal combustion engines. In this direction, it may be said, great advances have been made in recent years, and it is, perhaps, not too much to hope that the present generation will yet live to see a smokeless Britain, freed from the necessity of importing its supplies of motor fuel.

The Department of Scientific and Industrial Research has also sought to encourage the continued supply of adequately trained research workers by awarding scholarships and grants for materials and apparatus to graduates of the universities and to others similarly trained.

The work of the department was, at first, admittedly only an experiment, but it is now an experiment which has succeeded. The future of the application of science in industry in Great Britain is, I believe, full of hope; and although as a result of industrial depression and for other reasons the wave of enthusiasm for the application of science in industry may recede somewhat from the high-water mark of appreciation exhibited at the close of the Great War, there can be no ebbing of the tide to the level of pre-war years.

In the United States, as I am aware, even greater appreciation of the importance of science and of its applications for the material welfare of the people and for the industrial prosperity of the country has been shown by the federal government, by the states and by individual firms; and one can not fail to be profoundly impressed by the very large pecuniary resources now placed at the disposal of the scientific laboratories of the universities, both by the states and by private munificence, nor can one withhold admiration of the great and ever-swelling stream of new knowledge flowing from these laboratories.

While, however, we may rejoice that the importance of science in its applications to manufacturing processes and to the general activities of our workaday life has been so largely recognized, let us always bear in mind that the gospel of efficiency, while it may bring salvation to our industries, will, if carried into action without regard to higher considerations, be productive of great evil to the people and the country. For remember, efficiency calls for organization, and organization demands discipline; but as Sir Arthur Schuster so admirably put in some years ago: "Discipline is not inborn but is acquired by education and training. In an emergency it is essential to success, but if it be made the guiding principle of a nation's activity, it carries dangers with it which are greater than the benefits conferred." The loss

of individual freedom, the suppression of the sense of individual responsibility, the destruction of the human values and the conversion of man into a machine are too great a price to pay for industrial efficiency. From this evil root there can too easily spring the ruthless materialism and lust of power of which recent history has given us an example. No, let us beware of making a god of scientific efficiency; it is enough, as also it is necessary, that we make it one of the articles of our creed.

While the utilitarian appeal of science is at once the easiest to make and at present, perhaps, the most powerful to attract the interest of the community, it will, if pressed too strongly or too exclusively, result not in the development but in the decay of science and will weaken that pursuit of truth and knowledge on which the applications of science depend.

One often hears people at the present day speak as if pure science and applied science were two quite distinct and independent activities; and the so-called practical man, the man of business not specially trained in science and without the scientific habit of mind, is inclined to despise pure science and to insist that what is wanted is applied science. Now we know, of course, that there are not two sciences but only one science—there is science pure and unqualified, aspiring only to truth and knowledge, and there are the applications of science. There can be no application of science, no application of knowledge unless that science, that knowledge, previously exist. It is necessary to realize, it is necessary that the community shall realize that all the great revolutionary changes in our industrial life, all the great inventions which have so powerfully altered the character of our civilization have come not as the result of effort to achieve results of immediately utilitarian value, but as the result of a patient and persevering pursuit of knowledge without thought of practical or industrial applications. "These grand innovations," said Cuvier, "are only the facile applications of verities of a superior order, not sought with a practical intent, verities which their authors have pursued for their own sake, impelled solely by an ardor for knowledge. Those who put them in practice could not have discovered them; those who have discovered them had neither the time nor the inclination to pursue them to a practical result." The invention of the electric dynamo, for example, was rendered possible only by the previous discovery of electromagnetic induction by Faraday; the coal tar dye industry arose not out of an attempt to find some use for the evil-smelling liquid and still less as the result of a conscious effort to prepare from it a dye. The production of mauve did not come on the demand of the dyers (for who could have conceived the possibility of such a thing), but was the outcome of the purely scientific investigations of Perkin on the constitution of quinine. The X-ray tube also was not the result of a consciously directed effort to discover a means whereby we might, as it were, see through a brick wall, might examine the internal structure of the living body or of the inanimate crystal, but as the result of an investigation into the nature of the electric discharge in gases. And, lastly, the invention of the thermionic valve, which has rendered possible the transmission of the spoken word over the length and breadth of the earth, was rendered possible only by the study of the emission of electrons by hot bodies, carried out by men searching only for truth and knowledge. As Professor Whitehead has said: "Necessity is *not* the mother of invention; knowledge and experiment are its parents." "It is no paradox to say that in our most theoretical moods we may be nearest to our most practical applications." The applications of science to the utilities of our daily life may be the result of many years of laborious searching after knowledge, and although it is now widely, but not sufficiently widely recognized that the rule of thumb is dead and that the rule of science has taken its place, advance can continue to be made, even in the utilitarian domain, only if the people have acquired a faith in the power of science and have become convinced that the acquisition of knowledge, sought for its own sake alone, is the necessary precedent of all great inventions and applications of science.

Powerful as the utilitarian appeal of science undoubtedly is, it does not, I believe, and in the highest interests of mankind and of our western civilization I hope never will make the strongest appeal to the minds of thinking men or to men whose mental horizon lies beyond that of a purely materialistic existence. The numerous inventions which enter so largely into our modern life, the mechanical appliances and material benefits which have come from the applications more especially of physical and chemical science affect chiefly the machinery of life and are not the prime movers of men's actions; and over-emphasis of its utilitarian value may and I believe does do harm to the highest interests of science. It is, indeed, all too easy for the cynic to point to science not as the uplifter but as the destroyer of the finer qualities of mankind and to represent the aim of science as purely materialistic. The great danger, I would suggest, which we have to face in all our appeals to the community is that while proclaiming the great achievements of science in the creation of

pecuniary gain and material prosperity, we lose sight of the idealism of science and destroy the true sense of values by raising the lower above the higher, the material above the spiritual. The real claim of science to fuller appreciation by the community, the claim which we should seek to urge in all our publicity activity and propaganda, yes, and in all our schemes of education in school or university is the cultural, the spiritual and the moral importance of science. It is for the idealistic aim and not only for the materialistic purpose of science that we must endeavor to win appreciation. For the community as a whole it is not the acquisition of a knowledge of the facts of science but the becoming imbued with the spirit of science that is of chief importance.

What, then, is the scientific spirit which we desire that all men should cultivate, and on what grounds can we urge its cultivation? The first great aim of science is the seeking out of truth, the penetration into that unknown land which always we see lying half-veiled in mist beyond the continuously receding boundaries of the known. It is the beckoning finger of the spirit of truth and knowledge that lures the man of science forward. "It is the truth alone," said Scheele, "that we desire to know, and what joy there is in searching it out." It is, then, this desire for truth, the constant urge after truth, as the great German writer, Lessing, put it, that we must hold up as an aspiration to the community.

There are some who have been repelled by science and the scientific method of acquiring knowledge by the belief that science can explain nothing and that all it can do is to accumulate and record facts, the cold facts of science, as one has called them. But this is far from the truth. The recording of facts is one of the tasks of science, one of the steps towards truth, but it is not the whole of science. As Oliver Wendell Holmes said:

> There are one-story intellects, two-story intellects, three-story intellects with skylights. All fact collectors, who have no aim beyond their facts, are one-story men. Two-story men compare, reason, generalize, using the labors of the fact collectors as well as their own. Three-story men idealize, imagine, predict; their best illumination comes from above, through the skylight.

In these sentences we have summed up for us the steps of advance towards truth by the scientific method, towards the formation of those beliefs according to which, in the physical universe, we act. The universe is not a mere mass of uncoordinated facts and phenomena, but is like a noble edifice, the order and arrangement of whose stones are dominated by one grand idea, born in the mind of the architect. It is the work of the man of science, from partial glimpses illuminated by the light of inspired vision, to discover the divine idea by which the whole universe is ordered. Science, then, takes on a nobler and a higher purpose. As the poet, Alfred Noyes, has written:

> . . . What is all science, then,
> But pure religion, seeking everywhere
> The true commandments, and through many forms
> The eternal power that binds all worlds in one?
> It is man's age-long struggle to draw near
> His Maker, learn His thoughts, discern His law—
> A boundless task, in whose infinitude,
> As in the unfolding light and law of love,
> Abides our hope, and our eternal joy.

To the misconception regarding the work of science to which I have alluded is doubtless due the discrimination made by Sir Henry Newbolt between science and poetry—"Science is prose, poetry is imagination." Well, the facts and applications of science are no doubt prose, frequently very romantic prose; they are the results of observation and of reason by which man rises superior to the beasts and which mark the upward steps of civilization. But they are not the soul and spirit of science. The spirit of science is to be found in the great hypotheses and theories of science which, like poetry, are not the product of reason but of imagination and of inspiration which are superior to reason. For the great hypotheses of science are but attempts to gather within the bounds of a brilliant instant of inspired vision a multitude of experiences and to show the harmony of their parts. As Alfred Noyes again has said, "the great moments of science have an intense human interest and belong essentially to the creative imagination of poetry." In the great work of scientific exploration, in the work

> Of those who searching inward, saw the rocks
> Dissolving into the new abyss, and saw
> Those planetary systems far within,
> Atoms, electrons, whirling on their way
> To build and to unbuild our solid world,

and in the attempts to interpret the order and harmony of the universe, the man of science becomes the poet. Without imagination, the great discoveries of science could not be made. As the late Sir Benjamin Brodie, president of the Royal Society, said:

> Physical investigation more than anything besides helps to teach us the actual value and right use of the imagination—of that wondrous faculty which, left to ramble uncontrolled, leads us astray into a wilderness of perplexities and errors, a land of mists and shadows; but which, properly controlled by experience and reflec-

tion, becomes the noblest attribute of man; the source of poetic genius, the instrument of discovery in science.

The cultivation of the spirit of science appeals not only to the intellect, but creates also an emotional and esthetic pleasure and so ministers to that other side of the mental and spiritual life, the desire for beauty. The aim of science is the pursuit of truth and from the roots of truth springs beauty; and whether the truth be sought in the movements of the heavenly bodies, in the architecture of the molecules or in the grandeur of the sub-atomic universe, everywhere we find beauty. "Were nature not beautiful," wrote the mathematician Henri Poincaré, "she would not be worth knowing, life would not be worth living. I do not mean here, of course, that beauty which impresses the senses, the beauty of qualities and appearances; not that I despise it—far from it—; but that has nought to do with science; I mean that subtler beauty of the harmonious order of the parts which pure intellect appreciates." There are some indeed who moan that the joy and beauty of life have departed and that poetry has been buried under the facts of science. "The gods are dead," moaned W. E. Henley, the English poet:

> The world, a world of prose,
> Full-crammed with facts, in science swathed and sheeted,
> Nods in a stertorous after-dinner doze!
> Plangent and sad, in every wind that blows
> Who will may hear the sorry words repeated:
> "The gods are dead."

To this we must reply: the phenomena of nature do not lose in beauty as we gain an understanding of them; they become not less but more wonderful, the more fully we learn their meaning. Science does not destroy the beauty of nature, it interprets it; and the gods of joy, of beauty, of wonder and of poetry come back to life as we gaze on the mystery and beauty of the universe which science unfolds to our eyes, and as we see, in imagination, the possibilities of a fuller and nobler life through the widely and more widely opening doors of truth and knowledge.

Some there are who, impressed by the mighty achievements of science in the past and confident that still greater boons would be showered on mankind by the greater diffusion of scientific knowledge throughout the body politic, become impatient when they see, as Dr. A. D. Little has recently put it, "in the ranks of science knowledge without power and in politics power without knowledge"; and they demand for men of science a special position of power in the government of the country. Is this demand really justified? Is the claim made on behalf of the man of science not somewhat too arrogant? In connection with some of the practical activities of a government, in the planning and execution of schemes of a technical character, schemes for the conservation and economic utilization of natural resources, in the practical work of national defense, in the control of the purity of food, etc., the claims of the man of science are indisputable and have been largely recognized. But can we claim for men of science a special place in the general work of government, in the multifarious tasks of adjusting the conflicting claims, prejudices, aspirations of men not only amongst their own people but as between the different races of mankind? The man of science may, in Dr. Little's words, have "moved the earth from the center of the universe to its proper place within the Cosmos"; may have "extended the horizon of the mind until its sweep includes the 30,000 suns within the wisp of smoke in the constellation Hercules and the electrons in their orbits within the atom," but as a legislator these achievements will avail him little. It is not the 30,000 suns in the constellation Hercules but the 100,000,000 people of his own country that will claim his attention. It is not the motions of the electrons that he should understand, but the motives which influence human conduct; he should have expert knowledge not of atomic nature but of human nature, and human nature is not amenable to the laws of science. The more eminent a man is in the domain of creative science, the less successful is he likely to be in the field of politics; and to remove him from his laboratory to the legislative chamber would be to waste his special gifts and ability. One may expect to find agreement among men of science regarding the laws of science, but there is no reason to expect any unanimity among them in the domain of civil legislation. We do not strengthen but rather weaken the cause of science by making claims which neither experience nor reason can substantiate.

But while we ought not to claim for the man of science, as such, a special place in the machinery of government, we shall do well to encourage him to take a fuller share, perhaps, than he has hitherto done in the common duties of citizenship; to place more fully and unreservedly, at the disposal of his fellow men, that contribution of special knowledge and outlook which his training and studies enable him to make; to endeavor, without ostentation or arrogance, through social intercourse with men of different interests from his own, to form a more enlightened public opinion, and thereby to help in the solution of the educational, social, economic and other problems which face the community and country to which more especially he owes allegiance.

To cure or even to ameliorate the evils which flow

from the weaknesses to which all democratic government is subject, we must rather work for a greater knowledge and honesty of purpose, a higher cultural level, in the community as a whole; and although we must certainly beware of claiming that the diffusion of scientific knowledge and of the spirit of science is alone sufficient, we may safely claim that it would be an important factor in the moral and social development of the people. "The cultivation of science in its highest expression," to quote the words of Pasteur, "the cultivation of science in its highest expression is perhaps even more necessary to the moral condition than to the material prosperity of a nation." It is because science inculcates "veracity of thought and action" without which, as Huxley said, "there can be no alleviation to the sufferings of mankind," that we must work for its more widespread diffusion throughout all classes of the community. It is, moreover, largely because of its moral and spiritual value, as I have said, that we must claim the inclusion of science in our general educational curricula, whether of the schools or of the universities. A knowledge of the facts of science and of the physical universe in which we live is good and necessary, but if we fail to communicate to the student the spirit of science, the passion for truth, the spirit of cooperation, of tolerance, of charity and of unselfishness which are the spirit of true scientific endeavor, we shall have failed in our most important work.

In conclusion let me say that while we must urge the claims of science on the grounds both of its practical and spiritual value, we should do so with restraint and moderation, for, in pursuing truth according to the methods of scientific investigation, we must bear in mind that the truth to which we attain is only a partial truth. Let us always remind ourselves of the all-roundness of truth and let us remember that in our scientific approach we see but one side, one aspect of truth. Let us always recognize that through religion, art, literature and philosophy we have other paths of approach and see other aspects of the truth. Let us then carry with us the thought of the English poet, Sir William Watson, as expressed in his epigram, "The guests of heaven":

> Science and Art, compeers in glory,
> Boast each a haunt divine,
> "My place is in God's laboratory,"
> "And in His garden mine."

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UNIVERSITY OF ABERDEEN

REYNOLD ALBRECHT SPAETH

REYNOLD ALBRECHT SPAETH died in Bangkok, Siam, on June 26, 1925. In his untimely death zoology and physiology alike have lost a valued student; their followers the companionship of a rare and charming personality. In writing from Woods Hole, where for many summers he had made his home, I must express particularly the personal bereavement which so many of us feel, for he possessed in great measure qualities which endeared him to his fellows.

Spaeth was born in Philadelphia thirty-eight years ago, of a family containing many members distinguished for their achievements in medicine, theology, philosophy and literature. His schooling was received at the Germantown Academy and the North Eastern Manual Training School in Philadelphia. As a boy he was greatly interested in natural history and became proficient in bird photography.

At Haverford College his interests were first turned into definitely scholarly and scientific channels, largely under the influence of Professor Henry S. Pratt. Of this period a college mate, who later became one of his most valued friends, writes:

> I think he was the freshest freshman that ever entered the institution, and, with his usual alertness, as soon as he found how irritating this was he exaggerated it artfully. I was president of the sophomore class at the time and he annoyed me as much as he could. Later on we often laughed about it.
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> I remember that almost from the beginning of his sophomore year he began to be spoken of by the fellows in the college as some one a bit peculiar, since he had an extraordinary taste for settling down with Dr. Pratt in the biological laboratory and actually working over the classification of the small organisms in which he had become interested. During the four years when I was at college he was the only student who I remember doing anything intellectual for its own sake and because he liked it. The rest of us did what we were told. Some of us had sense enough to do this in a minimal degree; others, being rather more obedient, did a full stint, but I can not see that it ever netted much. I think that Ren was quite unique in the fact that he actually accomplished a piece of work, parts of which were published, during his undergraduate life at Haverford. I can emphasize the fact that I and several others viewed Ren with considerable wonderment because of his real attachment to this intellectual pursuit. I can even remember I envied him to some degree, and later, when I entered the medical school, I came to realize how much more his education must have meant to him than mine had to me.
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> He was always well liked, but owing to his powers of mimicry and his great capacity for detecting bluff he found it exceedingly easy to make enemies. As I see it now I believe that they sensed his greater degree of intellectual alertness and the fact that he did not hesitate to laugh at them.

The zoological work referred to was a study of the local distribution of the genus Cyclops and resulted in the publication of what I am told is the best existing description of the members of this group which occur in the eastern United States.

On graduating from Haverford College in 1909 Spaeth obtained a teaching fellowship at Harvard and entered on a four-year period of graduate study in zoology, under the guidance of Professor G. H. Parker. It was at this time that I first knew him, for I was an undergraduate taking courses in which he was the "assistant." I remember clearly the enthusiasm with which one day he showed me the beautifully simple contrivances he had worked out in connection with his researches on the chromatophores of fish. It was this abundant enthusiasm which distinguished him not only as a teacher but in all the things to which he turned his attention. And it was this perhaps, together with a certain assurance which was part of it, which gave me at that time the feeling that Spaeth was one for whom the future held something special in store. And this feeling, I think, was shared by other and wiser heads than mine.

The physiology of the chromatophores of fishes was the subject of his doctor's dissertation and occupied him for several years after the termination of the period of his graduate study. This was work of the first quality: thorough, comprehensive, imaginative, critical, of fine experimental ingenuity, ranging in its scope from painstaking accumulation of quantitative data to broad speculation on the relationships of chromatophores and other types of contractile cells. For his earlier work in this field he was awarded the Walker Prize by the Boston Society of Natural History. It was characteristic that this investigation was a distinct departure from the traditions of the laboratory in which it was done—a characteristic creditable to Spaeth and to that laboratory alike. At Woods Hole his attention had been drawn to the application of physical chemistry to biological problems, and he recognized clearly the fundamental nature of this method of attack. In his research he felt that his training in the physical sciences was deficient and extended his period of graduate study in order to ground himself thoroughly in these subjects. He concerned himself with the physical chemistry of protoplasm, utilizing his chromatophores as visible indicators of changes in the protoplasmic state. Höber's "Physikalische Chemie der Zelle und der Gewebe" became his handbook and long remained the most bethumbed book on his desk.

On being granted a Sheldon Traveling Fellowship by Harvard University in 1913 he spent the greater part of a year in Professor Höber's laboratory at Kiel, and occupied for a shorter period the Smithsonian Table at the Naples Zoological Station. On August 18, 1913, he had been married to Edith Eleanor Taussig. Shortly after their return from Europe their son, Walter, was born.

In 1914–15 he was instructor in biology at Clark College and during the following two years served as an instructor in the Zoological Department at Yale. Following this he held briefly an assistantship in the Hygienic Laboratory of the United States Public Health Service at Washington. During the summers of this period he was engaged in teaching embryology and, later, physiology at the Marine Biological Laboratory, Woods Hole. His investigations at this time were concerned in rounding out his work on chromatophores and particularly in attempting to utilize this material in pharmacological assaying. Several ideas occupied him also which, although they apparently proved fruitless, were interesting in indicating the bold and ingenious nature of his thinking. One of these involved an attempt to detect the possible radioactive formation of copper, using the extraordinary sensitiveness of certain organisms to this element as an indicator of its presence. Another led him to seek for differences in the optical activity of substances in the right and left blastomeres of dividing eggs.

In 1919 Spaeth became connected with the School of Hygiene and Public Health at Johns Hopkins University as an associate in physiology. It was his purpose to concern himself with the problem of fatigue in its relation to industrial and public health and he entered on his new duties by preparing a characteristically thorough review of the literature on this subject. His experimental work took several directions, but involved him chiefly in an inquiry into the relation between fatigue and resistance to infection. His position naturally forced on him the obligation of the scientist to the community at large, and he spent considerable time acting as consultant on industrial hygiene, in popular writing and in the preparation of moving pictures of marine animals. All this was excellently done, yet in the end this period is something of a disappointment. The experiment of setting a man trained in the fundamentals of general science on the practical physiological problems of the moment had not proved the success that had been hoped for. Perhaps it was inevitable that investigations in these problems should lack the fine qualities of his earlier work on chromatophores. Perhaps the very versatility of Spaeth's mind and the enthusiastic interest with which he met each new contact led to a scattering of his endeavors. At all events the outcome was disappointing, and at the

end of five years, when he should have felt that he had found himself and his problem, he believed that he was in a *cul de sac* and was ready for a change.

A year ago he was asked to take part in the reorganization of the medical school of the Chulalongkorn University in Bangkok, Siam, and accepted the appointment as professor of physiology. The opportunity, which this position seemed to hold out, to take up again problems in physiological zoology was welcome and the prospects which the tropical environment of Bangkok offered were not distasteful to his adventurous nature. At the same time he felt keenly the obligations which he was assuming toward the Siamese university and devoted the entire summer to preparing himself in those aspects of medical physiology with which he had not previously had experience. The enthusiasm with which he came to look forward to going out to Siam was well justified. From boyhood his avocations had developed him into a skilled field naturalist. He was very fond of shooting and fishing and was one of those persons with the knack of finding game where no one else had thought to look for it. His physique was exceptional; he had been an excellent athlete and could come back from a long day's hunting without a sign of tiring. With his rather broad knowledge of zoology and physiology as a background for these proclivities it seemed fair to hope for original accomplishment from him in the tropics. And in addition there was little fear that the inertia which so often comes with life in warm climates would quell the exuberance of his energies.

In October he moved his family, which had been enlarged by the addition of a daughter the year before, to Bangkok. He was very happy there; perhaps more happy than he had been anywhere before. He liked the place and the climate. He made friends there, as he always did readily. He felt that the opportunities for research were exceptional and that everything was coming his way at last. He was planning to investigate the oestrous cycle in monkeys, and had received a grant from the National Research Council in support of this work. During the spring he made three expeditions into the jungle for the purpose of collecting material for his studies. On all these trips he suffered some hardships—was in fact lost in the jungle without food for thirty hours on one occasion—but felt no ill effects which he could not, in his vigorous way, disregard. Apparently his energy and self-confidence led him to neglect the necessary safeguards of his health and he had become worn down by his activities more than he realized. In June, while in the midst of preparing a report on his research work, he became ill. Septicemia, resulting from the extension of an infection contracted on his first jungle expedition, had developed and in two weeks he was dead.

So ended the scientific career of Reynold Spaeth, before the promise of his early years could be fulfilled. But on another side he left a full achievement. For Spaeth developed richly the charms and virtues of his personality. He had a natural gift for entertainment: could sing and play and draw and mimic with a gentle humor which made him most engaging company. Eager, assured, a thoroughgoing individualist, with ready, witty tongue and quick insight he gave his mind openly to others, yet with a generosity and patent frankness which saved him from bitterness toward those he could not hold with. For one so prone to action his mind was philosophical and in a true sense religious. But most of all he had a zest for living. In the intensity with which he lived his life there was perhaps some recompense for its too short duration. For in the joy of life he never forgot the discipline of scholarship and was ever loyal to his scientific conscience.

ALFRED C. REDFIELD

SCIENTIFIC EVENTS

MEMORIAL TO VINAL NYE EDWARDS

ON September 1 there was unveiled at the Woods Hole Bureau of Fisheries a bronze tablet in memory of the late Vinal Nye Edwards. The *Fisheries Service Bulletin* states that Mr. Edwards was associated with the bureau and the Woods Hole laboratory from 1882 up to the time of his death in 1919, a period of nearly forty-seven years. It was he who first showed Professor Spencer F. Baird the marine life of the Woods Hole region, and it is probable that Woods Hole was selected as the site for the first biological laboratory of the newly established Fish Commission mainly because of the information Mr. Edwards was able to give. He was engaged as collector for the laboratory during all his long term of service, and his intimate acquaintance with the life of the region proved an invaluable aid to the advancement of biological investigation.

The movement to erect a memorial to Vinal Edwards was initiated in July, and the response in the form of contributions and interest was so immediate and generous that an order was soon placed for the tablet. The arrangements were in charge of a committee of which Dr. Edwin Linton was chairman. Dr. Linton himself has been associated with the Woods Hole laboratory since its beginning and was intimately acquainted with Mr. Edwards. The other members of the committee were G. R. Hoffses, Dr.

Herbert Rand, Franklin Gifford, Alice Smith Cowdry, Dr. R. P. Bigelow and Dr. W. H. Rich.

The tablet occupies a place in the main hall of the laboratory building. On it are inscribed the dates of Mr. Edwards's birth and death and the following words:

> This memorial to Vinal Nye Edwards is erected by his friends as a mark of their esteem, in recognition of his gifts as a naturalist and of his services to science.

The exercises were held on the lawn between the laboratory and the residence buildings and were well attended by the residents of Woods Hole and associates of the Marine Biological Laboratory as well as by the staff of the Bureau of Fisheries. The presentation address was made by Dr. Linton, who quoted from the many laudatory letters received from well-known American biologists who had known and worked with Vinal Edwards. The speech of acceptance was made by Lewis Radcliffe, deputy commissioner, and the unveiling was by Madison Edwards, a brother of Vinal Edwards.

A CALIFORNIA OIL WELL

DR. FREDERICK P. VICKERY, of the Southern Branch of the University of California, writes that on September 25 the Miley Oil Company's No. 6 well, located at Athens, Los Angeles County, California, reached the climax of a career of record breaking by becoming a producing well at a depth of 7,591 feet.

Some of the records established by this well are as follows: (1) Depth 7,591 feet. The deepest hole ever drilled, as well as (2) deepest oil well in the world. (3) Landed 4¾-inch, No. 15, casing at 7,591 feet. The longest string of pipe ever set. (4) Cemented 4¾ through perforations at 7,305. The deepest cement job ever attempted. (5) Took formation cores from depth of 7,570 feet and recovered perfect samples of good oil sand.

The well was drilled with rotary tools in a total of 230 working days, an average of 33 feet per day. The total cost of drilling, including labor, material and overhead, was $164,000, or $21.60 per foot.

The following casing was set:

15½-inch, No. 70, cemented at 988 feet.
8¼-inch, No. 36, cemented at 5,289 feet.
4¾-inch, No. 15, landed at 7,591 feet and cemented through perforations at 7,305 feet.

The well is producing about 150 barrels of 37° Be gravity oil per day with 20 per cent. of salt water. A gas lift is used to make the well flow, as pumping was considered impracticable on account of the depth.

THE FIELD MUSEUM EXPEDITION TO MADAGASCAR

A TWO-YEAR expedition to Madagascar, in search of the origins of the races now inhabiting the island, was started on October 15 by Ralph Linton, assistant curator of ethnology of the Field Museum of Natural History. He will work among the descendants of the Fatimite Caliphs who were driven out of Arabia and Egypt in the eighth century, and will also attempt to prove by an exploration of the entire island that it holds many of the oldest features of Malayan culture.

The peoples of Madagascar have long furnished a problem for ethnologists and archeologists. They are of mixed cultures, inclusive of three apparently main elements—Bantu negroes from Africa; the Hovas of Malay stock and a fringe of Arabs all along the coasts, the descendants of the Fatimite Caliphs. These three elements are sub-divided into fifteen or more main tribes which, in turn, are divided again into smaller partially distinctive groups. There are also hints of a pygmy element among the populations.

Mr. Linton, in his two-year stay, will explore the entire island, living with the tribes and making collections of their culture, ceremonials and domestic life which, when made the subject of scientific study, will show the history of the people despite their mixed bloods. The most extensive research will be made among the southern tribes who, despite the advanced stage of French activity on some parts of the island, are almost unknown to white men.

The natives of the island are expert in metal, textile and pottery making, and have for many centuries worked the gold mined on the island. A silk producing moth, unlike the Asiatic worm, is also cultivated. Beautiful cloth and baskets are woven from raffia, a fiber.

Mr. Linton will sail from New York and go first to London. He will spend two weeks in England, visiting and studying the Madagascar material in museums. He will also spend three weeks in similar work in France, sailing from Marseilles on December 10, and arriving in Tamatave, Madagascar, on January 7. Antananarivo, the capital of the island, will be used as the base for the expedition, which will immediately start work in a radius of that city.

SCIENTIFIC NOTES AND NEWS

DR. F. HENRY SMITH, professor of natural philosophy at the University of Virginia, celebrated his ninety-sixth birthday on October 14.

THE well-known histologist, Professor Camillo Golgi, of Pavia, recently celebrated his eighty-second birthday.

THE government of France has conferred the cross of the Legion of Honor, officer grade, on Dr. Charles L. Parsons, secretary of the American Chemical Society, and transmitted it to him through the French Ambassador at Washington.

DR. THOMAS BARBOUR, curator in the Museum of Comparative Zoology at Harvard University, was recently elected corresponding member of the Zoological Society of London and also of the Netherland Zoological Society of Amsterdam.

DR. E. L. STEVENSON, of New York, has returned from a six months' trip abroad, during which time he gave two lectures before the International Geographical Congress, which met in Cairo, Egypt, last April. On this occasion Dr. Stevenson had conferred upon him by the Egyptian government its highest decoration—grand officer of the order of the Nile.

THE Elia de Cyon prize of the Academy of Sciences at Bologna has been awarded this year to Professor H. Fredericq, of Liége, for his works on "The humoral mechanism of the action of various heart remedies in coldblooded animals." The second prize was given to Dr. L. Lotti for his research on "The vasomotor reflexes in young infants and the new-born."

DR. J. F. F. BABINSKI, of Paris, has been appointed honorary professor of neurology at the University of Vilna.

DR. ROBERT J. ANDERSON, chief of the nonferrous metals section at the Pittsburgh station of the U. S. Bureau of Mines from 1919 to 1924, has been awarded the William H. McFadden gold medal of the American Foundrymen's Association, in recognition "of his notable and distinguished achievements in the nonferrous casting industry and of his scientific contributions to the metallurgy of aluminium."

ON the occasion of his sixtieth birthday Professor Max Askanazy, director of the Institute of Pathological Anatomy at Geneva, was the recipient of a special number of the *Revue médicale de la Suisse romande* containing fourteen original articles dealing with pathology.

DR. PAUL GISVIUS, professor of agriculture at the University of Giessen, retired on October 1.

DR. CHARLES H. MAYO, of Rochester, Minn., president of the American College of Surgeons, will preside at the meeting of the society in Philadelphia on October 26, and will induct into office his successor, Dr. Rudolph Matas, of New Orleans.

DR. M. I. PUPIN, professor of electro-mechanics at Columbia University and president of the American Association for the Advancement of Science, is a member of the committee in charge of the observance of American Education week in New York. It is planned to have a series of conferences and an educational exhibition at the armory at Sixth Avenue and Fourteenth Street, opening on November 19.

PROFESSOR FRED R. FAIRCHILD, of Yale University, has been asked by the United States government to head a committee to inquire into and make a report on forest taxation in the countries of the world. With Professor Fairchild will be a group of forest and tax experts being organized by the U. S. Bureau of Forestry.

C. F. CURTISS, dean of the department of agriculture at Iowa State College and director of the Iowa Agricultural Experiment Station, has been named head of a committee from the cornbelt area to work with the state and federal authorities in finding ways to combat the European corn borer. The committee was selected following conferences in the borer infested regions of Ohio, Michigan and Ontario, Canada. Others who will work with Dean Curtiss are: C. V. Truax, Ohio state secretary of agriculture; F. W. Willits, Pennsylvania state secretary of agriculture; Dr. C. E. Woodbury, of the American Canners' Association; Dean W. C. Coffey, University of Minnesota; Dean L. E. Call, Kansas State Agricultural College; Dean H. W. Mumford, University of Illinois, and Dean E. A. Burnett, University of Nebraska.

DR. GEORGE CHRISTOPHER CLAYTON, M.P., and Professor Henry Cort Harold Carpenter, F.R.S., have been appointed members of the advisory council to the British Committee of the Privy Council for Scientific and Industrial Research.

DR. E. D. BALL, director of scientific work in the United States Department of Agriculture, has been appointed associate entomologist of the Florida State Plant Board.

DR. WILLIAM B. WHERRY, professor of bacteriology at the University of Cincinnati, has been appointed a member of the Cincinnati Board of Health to succeed the late Dr. Edward Walker.

DR. ELMER A. HARRINGTON, formerly head of the department of physics at the Massachusetts Agricultural College and during the past year special investigator on X-ray methods at Harvard University, has been appointed research associate on the Portland Cement Association fellowship staff at the Bureau of Standards.

PROFESSOR HENRY F. JUDKINS, head of the department of dairy manufactures at the Massachusetts Agricultural College, has been granted a leave of absence to go to Springfield to be production manager for the Eastern Dairy Association.

DR. GILBERT H. GROSVENOR, president of the National Geographic Society, has returned after three months in Europe. He will go to Santa Fé, N. M., to join Neil M. Judd, who is completing five years' work as head of the Pueblo Bonito Expedition.

DR. GEORGE GRANT MACCURDY, of Yale University, director of the American School of Prehistoric Research, has returned to the United States. During the summer he visited, with sixteen students, seventy-seven prehistoric sites in England, France, Germany, Spain, Switzerland and Belgium.

DR. H. MOLLET and several other Swiss scientists left on October 7 for Sumatra, for the purpose of observing the eclipse of the sun on January 14 on behalf of the Berne Astronomical Institute.

DR. PIERRE JANET, professor of psycho-pathology in the Collège de France, is visiting the United States, following an official mission to Mexico. During the past week Dr. Janet gave a number of lectures and clinics in Philadelphia.

SIR WILLIAM ARBUTHNOT LANE, the distinguished British surgeon, sailed on October 14 on the liner *Majestic* to attend the meetings of the American College of Surgeons in Philadelphia.

PROFESSOR NAKEDATO, director of the Tokio Observatory, has arrived in Moscow to visit the observatory of Moscow University.

PROFESSOR CALVIN H. KAUFFMAN, of the department of botany of the University of Michigan, has been granted sabbatical leave for the first semester of the academic year 1925–26, and expects to devote that period to field study in the Pacific Coast States.

MRS. MARGARET H. MOSS, of the University of Witwatersrand, Johannesburg, South Africa, is coming to Wellesley College as an exchange professor in botany. Miss Alice M. Ottley, associate professor of botany in the college, will take her place in South Africa.

DR. SIMON FLEXNER, director of the laboratories of the Rockefeller Institute for Medical Research, and Dr. Wm. H. Welch, director of the Johns Hopkins School of Hygiene and Public Health, were speakers at the semi-centennial exercises of the founding of Vanderbilt University which took place on October 15 and 16.

WE learn from *Nature* that in honor of the founder of the British Science Guild, Sir Norman Lockyer, the council has established an annual Norman Lockyer lecture, one of the objects of which is to direct the attention of the public to the influence of science upon human progress. The first lecture will be given by Sir Oliver Lodge, on November 16, upon the subject of "The link between matter and matter."

THE Harveian Oration will be delivered before the Royal College of Physicians of London on October 19, by Sir Frederick Mott, M.D., F.R.S., on "The progressive developments of Harvey's doctrine of *Omne vivum ex ovo*."

AN edition of the complete works of Dr. William S. Halsted, late professor of surgery at the Johns Hopkins University, is under way, edited by Dr. Walter C. Burket, Evanston, Ill., in two volumes. As an introduction to the edition, a biographic sketch of Dr. Halsted is being written by Dr. William H. Welch, director of the Johns Hopkins School of Public Health and Hygiene, who is the oldest living associate of Dr. Halsted. Dr. Halsted was associated with the Johns Hopkins University from 1881 until his death in September, 1922.

THE memory of André Parmentier, horticulturist and founder of the Brooklyn Botanical Garden, was honored on October 17 at the unveiling of a tablet within the garden near the entrance at Eastern Parkway and the Brooklyn Museum. Dr. C. Stuart Gager, director of the garden, accepted the bronze plate bearing an account of Parmentier's purchase of the land one hundred years ago. Johnston Mali, Belgian Consul in New York, presented the tablet in behalf of the Parmentier-Bayer Centenary Committee.

ARRANGEMENTS are in progress by the Italian Associazione Nazionale Industrie Elettriche to celebrate in a suitable manner the centenary of the death of Alessandro Volta, which took place near Como on March 5, 1827.

DR. FRANCKE HUNTINGTON BOSWORTH, emeritus professor of laryngology at the University and Bellevue Medical College, New York City, died on October 17, in his eighty-third year.

DR. E. J. BABCOCK, professor of chemical metallurgy and dean of the college of engineering at the University of North Dakota, died on September 3, aged sixty years.

PROFESSOR HAROLD MAXWELL LEFROY, of the Imperial College of Science, London, died on October 14 from the effects of poisonous gases upon which he was experimenting.

PROFESSOR EDWIN HENRY BARTON, F.R.S., dean of the faculty of pure science in the University College of Nottingham, died on September 23, at the age of sixty-seven years.

WITOLD CERASKI, emeritus professor of the university and former director of the Observatory of Moscow, Russia, has died at the age of seventy-six years. He was much interested in celestial photography and

his wife, Mme. L. Ceraski, discovered many variable stars on the plates taken at Moscow.

AUGUSTUS O. EIMER, whose death occurred on April 13 last, left his entire estate to his widow as residuary legatee. It is eventually to come to Columbia University and consists of capital stock of the firm of Eimer and Amend, manufacturers of scientific apparatus and chemicals.

ANNOUNCEMENT has been made of gifts to Columbia University totaling $111,615. This sum includes $15,000 from the Borden Company for research in food chemistry and nutrition, and $5,000 from the Walker Gordon Laboratory Company for the same purpose. The Commonwealth Fund has contributed $15,000 to constitute the Psychiatric Commonwealth Clinic Fund, and $5,000 to meet the cost of educational researches to be conducted by the university. Other gifts were $2,500 from Edward D. Faulkner to be applied towards the cost of research work in the department of surgery, $2,000 from E. E. Olcott for the establishment of the "Robert Peele prize" in the school of mines, $2,000 from Eli Lilly and Co. for the pernicious anemia fund in the department of pathology, $1,000 from Rohm & Haas Co. to maintain a research fellowship in biological chemistry, and $900 from Mrs. Elsie Clews Parsons for work in the department of anthropology.

THE United States Civil Service Commission announces open competitive examinations for the following positions in the forest service: Senior forester, $5,200; senior forest economist, $5,000; forester, $3,800; forest economist, $3,800; associate forester, $3,000; associate forest economist, $3,000; assistant forester, $2,400, and assistant forest economist, $2,400. Receipt of applications will close on November 17. Competitors will not be required to report for a written examination, but will be rated on their education, experience and on a thesis or publications which must be filed with their application.

DR. WILLIAM G. FOYE, secretary of the New England Intercollegiate Geological Excursion, writes that the twenty-first excursion was held in the vicinity of Waterville, Maine, on October 9 and 10. Professor E. H. Perkins, of Colby College, was the leader. On October 9 the party visited localities near Waterville where the Silurian slates are exposed. Specimens of *Nereites deweii* and *Monograptus colbiensis* were collected. During the afternoon the glacial geology about the Belgrade Lakes was studied. On October 10 automobiles carried the group to Litchfield, west of Gardiner, at which place the rare rock type Litchfieldite containing sodalite and cancrinite was collected. Later in the day Mount Apatite and its gem bearing pegmatites was visited, at Auburn. Twelve institutions were represented on the excursion: Bowdoin, 1; Clark, 1; Coburn Institute, 1; Colby, 4; Dartmouth, 1; Massachusetts Institute of Technology, 4; Middlebury, 1; Mount Holyoke, 2; New Hampshire State, 3; Wellesley, 4; Wesleyan, 2; Williams, 2; unattached, 2; total 28.

THE new discovery of high grade uraninite ore on the western coast of the White Sea is expected to give the Soviet Union a full supply of domestic radium, according to a bulletin from the Russian Academy of Sciences received by the Russian Information Bureau. Hitherto Russian scientists have had to depend on supplies of radium imported from abroad. The samples brought to Leningrad by A. N. Lobunzev, geologist, from the White Sea expedition, have been analyzed by the Radium Institute of the academy, which reports the ore as rich in uranium as ore obtained in Joachimsthal, Czechoslovakia. The academy has dispatched an expedition headed by A. E. Fersman, chief mineralogist, to the White Sea, to make arrangements for securing the ore in quantity.

AN epidemic goiter survey of Massachusetts will be made this fall and winter, if the State Department of Health can complete its tentative arrangements with the United States Public Health Service in Washington. Dr. George H. Bigelow has conducted a preliminary sounding at home and has mapped out the survey. The probabilities are that Dr. Robert Olesen, a surgeon in the employ of the United States Public Health Service, will be sent to Massachusetts to conduct the same kind of a survey that he made in Colorado last year. His services are wanted there because of his experience in Colorado, as his method of procedure will permit an interpretation of the Massachusetts results in the light of a comparison with those of Colorado. The first concern of the heauth authorities is whether there is an undue prevalence of endemic goiter in Massachusetts, and the next step will be to establish its relationship to the iodine contents of the drinking water and incidentally also the iodine contents in the soil.

THE annual report for 1924 of the inspector, Dr. J. A. Giles, under the act for regulating experiments on living animals in Great Britain has been issued. The number of persons holding licenses for such experiments was 1,042, but of these 239 performed no experiments during the year. The total number of experiments made was 177,815, or 43,032 more than in the preceding year. The whole of that increase is accounted for by the larger number of simple inoculations and similar experiments performed without anesthetics, and there was a decrease of 893 in the number of operations performed with anesthetics.

Dealing with the latter class the report says: "Of the 9,162 experiments 1,109 were simple inoculations into the skin of guinea pigs, which were anesthetized in order to keep the animals motionless during the introduction of a minute quantity of the fluid to be tested for the purpose of standardization. Of the remaining 8,053 experiments in this table, comprising all the cases in which any serious operation was involved, 4,324 were performed under license alone, or under certificate C, and therefore came under the provision of the act that the animal must be kept under an anesthetic during the whole of the experiment, and must, if the pain is likely to continue after the effect of the anesthetic has ceased, or if any serious injury has been inflicted on the animal, be killed before it recovers from the influence of the anesthetic."

AN attempt is being made to preserve the Indian totem poles in the vicinity of Hagelton, Kispiox, Hagwelgate, Gitsegyukla and Kitwanga, British Columbia. The poles at Gitsegyukla and Kitwango may be seen from the Canadian National Railway car windows. So far as known this Canadian government railway is the only one in the world from which totem poles may be viewed. The work is being carried on under the Canadian Department of Indian affairs. Harlan I. Smith, of the National Museum of Canada, is in charge in the field and is assisted by T. B. Campbell, in the engineering problems, and H. F. Ballentyne in the art and architectural work.

THE U. S. Department of Agriculture reports that the nation-wide drive to eradicate bovine tuberculosis up to April 1 included 10,201,492 cattle under supervision; 6,777,624 cattle in herds successfully passing the first test; 1,187,908 cattle in fully accredited herds; 617,810 cattle tested during March, 19,841 cattle reacting to the test during March; 3,498,072 cattle on the list to be tested, and sixty-nine counties recognized as free from bovine tuberculosis. Reports show unusual interest in tuberculosis eradication on a county-wide basis. In the first three months of the year, the number of counties having less than 0.5 per cent. of the disease increased from fifty-three to sixty-nine. Veterinary officials of the Bureau of Animal Industry consider that such progress is proof of the practicability eventually of freeing entire states from bovine tuberculosis.

WE learn from the *Journal* of the American Medical Association that, in accordance with plans prepared by the committee to investigate the health hazards of tetra-ethyl gasoline, the U. S. Public Health Service is carrying on chemical and clinical studies in various parts of the country of the manufacture, distribution and use of this gasoline product. Surgeon General Cumming has detailed Dr. J. F. Leake to assume charge of all these investigations and to cooperate with the director of the Hygienic Laboratory and with medical officers of the section of industrial hygiene and sanitation. Two fields of study have been determined on. One of these will be in a Middle Western city where tetra-ethyl lead gasoline has been in use for several years. In this city investigations will also be carried on in an experimental garage where this gasoline has never been used. Identical experiments will also be carried on in an Eastern city.

THE Federation of Bird Clubs of New England has been presented with Milk Island, off Rockport, for a bird sanctuary. This island, the gift of Mrs. Roger W. Babson, will be presented to the state by the federation. The island comprises about fifteen acres. The officers of the federation will present it to the state as a bird refuge in perpetuity, and the island will be known as the Knight Bird Refuge in memory of Mrs. Babson's father and mother. By this gift the Commonwealth of Massachusetts will have by the end of this year seven islands for bird sanctuaries, acquired either as gifts or by purchase by the federation. These islands are Egg Rock in Lynn Harbor, Ram Island, off Mattapoisett, Carr Island, off Newburyport and the Merrimack River, Tern Island, off Chatham, Smith's Island, off Nantucket, and Penikese in Vineyard Sound.

THE American Museum of Natural History announces that the museum architects, Trowbridge and Livingstone, are collaborating with Howard Russell Butler, of Princeton, in the preparation of plans for the proposed new astronomical hall which is to occupy the place of the present auditorium. This hall will include five floors and will cost $2,000,000. The first floor will be devoted to the museum's large collection of meteorites. On the second floor will be a great hall, extending through the third floor, for astronomical models and exhibits, while the astronomical hall proper will extend from the fourth floor through the fifth and sixth floors and will be capped by a huge dome, which will represent the heavens with the constellations.

UNIVERSITY AND EDUCATIONAL NOTES

DR. G. B. FRANKFORTER, of the University of Minnesota, has become professor of chemistry at Stanford University.

DR. HILDING BERGLUND, a native of Sweden who has been an assistant professor in the Harvard Medical School since 1923, has been elected professor of

medicine and head of the department of medicine in the University of Minnesota Medical School. He succeeds Dr. S. Marx White, who has resigned to devote his full time to private practice.

DR. BURTON CLARK has been appointed associate professor in the department of geology at the University of South Carolina.

JOHN GIESEN, assistant professor of zoology in Marquette University, Milwaukee, has resigned to become head of the department of zoology in Holy Cross College, Worcester, Massachusetts.

DR. FREDERICK H. ALLEN, director of the All-Philadelphia Child Guidance Clinic, has been appointed associate in psychiatry, and Dr. Richard H. Paynter and Dr. Phyllis Blanchard, psychologists of the clinic, instructors in psychology in the graduate school of medicine at the University of Pennsylvania. They will have charge of the instruction in psychiatric and psychological methods in child guidance work of the neuro-psychiatric fellows of the Commonwealth Fund of New York City.

AT the New York Homeopathic Medical College and Flower Hospital the following appointments are announced: Dr. J. George Brody, professor of physiology and pharmacology; Dr. Laura Florence, assistant professor of histology and embryology; Dr. Hans Anderson, assistant professor of pathology; Dr. C. Saul Danzer, assistant professor of experimental medicine; Dr. Gregory Schwartzman has been promoted to be professor of bacteriology.

DR. WINFRED OVERHOLSER, a member of the Massachusetts Commission on Mental Diseases, has been appointed professor of psychiatry in the faculty of the Boston University School of Medicine to succeed Dr. N. Emmons Paine.

NORMAN C. MILLER, head of the engineering extension department of Pennsylvania State College, has resigned to become director of extension teaching at Rutgers University.

PROFESSOR H. V. A. BRISCOE has been made director of the department of chemistry at Armstrong College, Durham, in succession to Professor W. N. Haworth, now professor of chemistry in the University of Birmingham. Professor Briscoe has been for several years professor of inorganic and physical chemistry in Armstrong College. Dr. G. R. Clemo, of the British Dyestuffs Corporation, has been appointed professor of organic chemistry in the college.

PROFESSOR HANS CLOOS, of the University of Breslau, has been appointed professor of geology and paleontology at the University of Bonn, to take the place of Professor G. Steinman, who has been made professor emeritus.

DISCUSSION AND CORRESPONDENCE

BOTANICAL CRITICISM

ARE American botanists excessively polite?[1] Certainly they do not indulge in mutual criticism as a major activity. Most of us will agree that without discussion knowledge can not prosper. It is coming to be pretty generally admitted that the badly crowded programs at botanical meetings stifle even the most necessary discussion. On the whole, however, botanical criticism is not a matter of machinery, but of atmosphere. The columns of many journals are open, and publication is easy—too easy, the mathematicians and chemists tell us.

One may as well grant that our civilization is one which makes a specialty of avoiding friction. It has even been eliminated as bargaining from the age-old business of retail selling. "Knocking," as a source of friction, is a capital social offense and in the mind of the average man comprehends criticism in all its phases. But may we not also grant that science rises above such considerations?

The cause of inadequate criticism is not so patent. To put it bluntly one can not have criticism without having the critical attitude of mind. And the only truly critical mind is the educated mind.

As a matter of course science must attract large numbers of youths who are fascinated, not by the ideas involved, but by the manipulations to be performed. Any botanist who knows his field can name instances where the ideas of one man are at present engaging the hands of anywhere from five to fifteen other men.

Skill is a noble thing, but it does not guarantee an intellectual atmosphere. It is essential to know a good preparation from a bad one, or to distinguish a correlation from a coincidence, but that is not enough. In reality science consists not of things nor of events, but of ideas. So far as the scientist is concerned ideas have relative values. It is the task of criticism to assign these values. The great strategists in science have been great selectors in the field of ideas.

Naturally the business of criticism is no child's play. It is work for good minds that have been severely trained. One recalls a well-known teacher of botany who took actual pride in his "discovery" that it required no especial ability to become a botanist! If this opinion were very widely shared one would not have to look far for an explanation of the dearth of botanical criticism.

In addition to the need for ability there is the question of adequate training. The writer has been

[1] Rose, D. H., and Stevens, N. E., "The excessive politeness of American botanists," SCIENCE, 61: 656–657, 1925.

repeatedly struck, during his teaching experience, by the sound discrimination *in dealing with scientific ideas* displayed by students trained in the humanities. As a rule they have shown a better sense of values than students whose experience has been primarily scientific. Is it not possible that the drive against the humanities has been too successful? These subjects concern themselves with the task of evaluating ideas. Does the science student, busy with the acquisition of descriptive details and technique, have any proper substitute for them?

The choice seems fairly clear. On the one hand we may rigorously select those whom we permit to go ahead as botanists and see to it that they are soundly educated. Even so there will be many useful workers interested primarily in manipulation, but their interest should not be a blind one. On the other hand we may encourage students of mediocre intelligence and narrow training to fill the ranks. If we choose the latter course we commit ourselves to a policy of helotism in the realm of ideas. In such case it will be a cause for thankfulness rather than chagrin if those who perform the routine have nothing to say concerning the significance of their work.

PAUL B. SEARS

UNIVERSITY OF NEBRASKA

FUNCTIONAL DIVISIONS OF THE NERVOUS SYSTEM OF INSECTS

FROM time to time attempts have been made to homologize structures in widely separated groups of organisms. This is interesting but apt to be rather unsafe. The functional divisions determined in the nervous system of vertebrates have aided greatly in the determination of the nature of the various parts of this complex system.

In insects there is a similar complexity of function and structure. An analysis of the parts of the nervous system of arthropods in terms of function has been going on for some time. In no other group, with the exception of the vertebrates, has so much been done. However, somewhat different methods must be used and our knowledge is far from complete. Regeneration methods, for instance, are not very successful, nor are degeneration tracts easily traced. The chief method, then, for determining peripheral and central parts is by the use of the intravitam methylene blue stain followed by dissection. In a few cases serial sections may be used, but the tough body-wall often hinders the preparation of perfect slides.

Two years ago I found an exceedingly valuable source of material for this study in the flat, transparent larva of the beetle Dendroides. In this insect it was possible to trace practically all parts of the nervous system in abdominal segments. In a successful preparation there was a bewildering abundance of nerve structures shown with a clearness and completeness of detail that was remarkable. This often included both the central and peripheral systems at the same time. There were details in the central ganglia, the nerves of the intestine, of the heart, the nerves of the spiracles, nerves to all the muscles of the segment including both afferent and efferent terminations and the extensive receptor system of the body-wall. It was from the results of such a study that it was determined, for instance, that muscle cells had both afferent and efferent terminations, the former by means of bipolar cells located on the muscle fibers, the latter by extensive complex end-plates supplied by nerve cells from the ventral ganglia by a special motor branch. It was also determined that at least ten nerve cells supplied each muscle fiber of larger size. It was determined that the so-called median nerve was composed of two parts and that the lateral nerves from these strands had components, from both above and below, from cells in the two nearest ganglia. The lateral nerves were traced to spiracles. It was determined that the so-called heart was supplied by strands from the motor branch of each ganglion; the fibers from these nerves were not all confined to the segment from which they spring. It was determined that the intestine was supplied by visceral ganglia which give rise to a superficial and a deep plexus with motor fibers from the central ganglia and sensory fibers from the intrinsic nerve cells of the plexus. It was found that the superficial nerve plexus contributed to the afferent and efferent supply of the Malpighian tubules.

Other recent studies have added much to our knowledge of the nervous system of insects, notably Zwarzin (*Zeit. f. wiss. Zool.*, 1924) and Orlof in the same publication. As a result of their work and mine the following seems to be true:

(1) The visceral system of insects consists of the so-called visceral ganglia in the head region with nerve extensions along the digestive tube. Receptor cells in the wall of the intestine of a bipolar or tripolar nature may in part be from muscles. The effector cells seem to be located in the visceral ganglia.

(2) The somatic system consists of bipolar cells ending in hollow hairs of the body-wall. Similar cells and some of a tripolar nature end in the body-wall without hairs. These also seem to be receptors. The effectors are located in the ventral ganglia of each segment and supply nerve endings to the body muscles.

(3) Fibers or cells or both often form a peripheral

network in the skin between the bipolar terminations. These may associate the different regions.

(4) The so-called unpaired nerves send lateral branches to the spiracles. They are not a part of the sympathetic system.

(5) Heart muscles in part seem somatic, judging from their nerve supply.

(6) Various functional divisions of the ventral ganglia made in terms of peripheral nerves such as shown by Zwarzin are suggestive but far from conclusive as yet.

WILLIAM A. HILTON

POMONA COLLEGE
CLAREMONT, CALIFORNIA

THE INDEX GENERALIS

THE "Minerva," or annual of the universities, which had a very modest beginning, but grew in the course of years until it had the proportions of a lexicon for a foreign language, had come to be more and more depended upon by university men as an indispensable book of reference. Published by Karl Trübner, of Strassburg, it came to a sudden end with the outbreak of the European war.[1] Now once more in possession of Alsace, it has been a matter of pride for the French to take over the task of supplying a university annual, and under the name *Index Generalis* they have issued an enlarged and improved "Minerva."[2]

Two ministries have made subventions for the publication and the huge task appears to have been taken very seriously. The value of such a work must depend very largely upon the correctness and the recent date of the information collected, and in no small degree upon the proofreading. It is a pleasure to be able to record the distinct success of the project in each of these respects. The volume which has just issued from the press is the second of the new series, the first having appeared a year ago.

Until new and satisfactory classified lists of scientists have appeared, the list of savants near the close of this volume can be made to serve. It covers no less than 366 closely printed pages and includes the names and addresses of about fifty thousand savants. Some difficulty seems to have arisen with the press work, for the forms could not have been very securely locked. Though many letters have fallen out, so large is the list and so accurate the alphabetical arrangement that most of the missing letters can be supplied.

Abbreviations have been used very extensively so as to reduce the compass of this work, and a little practice is necessary before one makes ready use of the volume. A feature of special interest is the complete list of members of all national societies of savants. A wise innovation has been the use of the English language for the sections devoted to the British and American institutions.

WILLIAM HERBERT HOBBS

UNIVERSITY OF MICHIGAN

BAUXITE AND SIDERITE

DR. E. N. LOWE, director of the Mississippi Geological Survey, who has published in SCIENCE, May 8, 1925, certain comments on recent papers of mine on bauxite, is correct in his belief that no discourtesy to him or to the Mississippi Survey was intended in my comments on the failure of two generations of geologists to capitalize Hilgard's description. I merely considered it as something of a joke on our profession to have a prospector make the discovery, for I also was among the geologists who had worked in the region without suspecting the presence of bauxite.

In Dr. Lowe's communication to SCIENCE it is not made clear that I published two papers, the first on "Bauxite associated with siderite," read before the Geological Society of America December 28, 1923, and submitted January 14, 1924, for publication by that society, and the second, a bulletin published by the United States Geological Survey about a year later on "Bauxite in Northeastern Mississippi." This latter bulletin is not mentioned by title by Dr. Lowe, but illustrations which were used in it are referred to, whereas none was used in the paper published by the Geological Society. It was stated that I forgot completely to mention that the Mississippi Geological Survey had promptly arranged with the prospecting company to secure the results of their accurate and detailed prospecting, but this statement surely can not refer to my Geological Society paper, which was prepared and submitted for publication before the state bulletin was available to me in any form for quotation or reference, nor could the U. S. Geological Survey paper (Bulletin 750–G) have been referred to.

At my request there were sent me page proofs of the state bulletin on March 21, 1924, nine weeks after the manuscript of my Geological Society paper had been sent to the society. The proofs were desired in

[1] "Minerva" resumed publication under the same editorship in 1923. It is published by the successor of Karl J. Trübner, Walter de Gruyler & Co., Berlin and Leipzig.

[2] Index Generalis, Annuaire Général des Universités, Grandes Écoles, Académies, Archives, Bibliothèques, Instituts Scientifiques, Jardins Botaniques et Géologiques, Musées, Observatoires, Sociétés Savantes; Publié sous la Direction de R. de Montessus de Ballore, Professeur Libre à la Faculté des Sciences de Paris, Ouvrage honoré de souscriptions du Ministère de l'Instruction Publique et du Ministère des Affaires Etrangères. "Edition Specs," 17 rue Soufflot, Paris, 1924–1925, pp. 21–36.

order that specific references might be made to the state bulletin in my U. S. Geological Survey paper, as it would appear long before the latter and would cover much the same ground. There are actually twenty or more references to the Mississippi Survey bulletin or to the work of W. C. and P. F. Morse given in the forty-six pages of the text of the U. S. Geological Survey bulletin, besides numerous references to the analyses by Dr. W. F. Hand, of the Mississippi Agricultural College, and to the material furnished me by the Mississippi Bauxite Co.

I have herein endeavored to make clear what is not clear in Dr. Lowe's letter—namely, that I have published two papers, one of which was sent to the Geological Society before the Mississippi report was available for reference, and that the second, or Federal Survey report, contains many references, giving full credit to Mississippi Survey Bulletin 19. In view, therefore, of the absence of intent to reflect on any of the geological workers, and in view of the specific credit that has been given in the survey bulletin to the Mississippi Geological Survey and others whose results were used, I trust that the charge that I have been guilty of a "lapse of courtesy" may be considered as without adequate basis.

E. F. BURCHARD

UNITED STATES
GEOLOGICAL SURVEY

SCIENTIFIC BOOKS

MEDICAL RESEARCH IN CHINA[1]

IN the "Contributions from the Peking Union Medical College" will be found a record of contributions to medical science which have been made under peculiar and interesting conditions, without parallel in history.

Here, within the great oriental city of Peking, have been transplanted the seeds of western learning, which are wholly different from the influences that have hitherto shaped the destinies of Chinese civilization. Instead of attempting to obtain truth through the power of the human intellect alone, as did the ancient Chinese philosophers, to whom all thoughtful persons owe a debt of gratitude, stress is placed upon the experimental method, upon accuracy in observation and upon skill in deduction. Thus, the problem of "the transformation of the mind of China" is faced, in a constructive sense, in the most humanitarian of sciences. But to be successful more is needed than a revolutionary point of view among the intellectuals and the generation of a lively feeling of compassion and of personal responsibility for the sick and dying. It is also essential that the attitude of the people as a whole to the medical profession be changed, that the status of the profession be raised from that of an unattractive cult, drenched in superstition, and pursued by men of little training and few ideals, to one which will appeal to the genius of the best minds of China. It is probably with this objective in mind that the reorganizers of the Peking Union Medical College selected for a site the palace and estate of a Manchu prince and that they erected thereon buildings which constitute a wonderful blend of the best in Chinese and foreign architecture, with the result that the college as it now stands possesses a dignity all its own and commands admiration in a capital famed for its architectural masterpieces.

The volumes under review are prefaced by a brief introduction written by the director of the college, in the course of which the following statements appear:

> In establishing the Peking Union Medical College its trustees have laid emphasis on the encouragement of research, especially with reference to problems peculiar to the Far East. . . .
>
> The problems and potentialities of the Orient, political, economic and scientific, have been drawing the interest of the world to this hemisphere with increasing force during the past few years. In the field of medicine, particularly as regards communicable disease, Asia compels a growing attention from physicians, sanitarians and government forces. China and its neighboring countries are being recognized as reservoirs of certain diseases, endemic in localities specially favoring their existence, and on occasion becoming epidemic with a velocity and extent which keeps even pace with the increase in transportational facilities and the growing readiness of the Chinese to move about the country. . . .
>
> Various other morbid conditions are of special interest; the animal parasites of man are particularly abundant in China and offer unusual opportunities for studies in bionomics; anemias associated with splenomegaly of uncertain origin are frequently seen; diseases arising from dietary abnormalities offer an inviting field for the food chemist and the clinician alike. The investigation of physiological and anatomical norms of the Asiatic has scarcely begun. To these and kindred problems it is hoped that, as time goes on, the studies carried on in the laboratories of this institution may make an effective contribution.

The contributions themselves number 211, of which 91 are given only by title. Their subject-matter is so varied that to review them adequately would require the close cooperation of specialists in all the main branches of medical science. They range from very brief notes on special topics to a cooperative monograph on Schistosomiasis japonica of over three hundred pages. For a single individual to attempt to give more than a general and very superficial idea of their contents would savor of the presumptuous. They are arranged without order as to subject-matter, anatomy rubbing shoulders with pharmacology and

[1] "Contributions from the Peking Union Medical College, Volume I–IV, 1921–1924, Peking, China.

clinical neurology with dietetics, so that in these days of specialization the honest reader may well admit that it is difficult fully to comprehend six consecutive articles. But he will notice that there is evidence of a clear appreciation of the great purpose dominating the enterprise. The contributions lend themselves to definite grouping which may or may not have been premeditated. Indeed, this circumstance may constitute merely the unconscious expression of a well-balanced medical faculty, in which each individual attacks the problems which he is by nature and training best fitted to solve.

(1) Thus, the subject of the history of Chinese medicine is logically made the basis for several communications written by both Chinese and foreigners. An obvious effort is made, not to present certain peculiar practices and customs as curiosities to be wondered at, as has been so frequently done in the past, but rather to penetrate more deeply and to discover the underlying causative factors which alone will furnish the necessary background for the introduction of what we are pleased to call "modern" medicine. The scope of this inquiry, which should be broadened, is revealed by the following titles: "A review of ancient Chinese anatomy," "Taoist ideas of anatomy," "The office of imperial physicians," "The renaissance of medicine in China," a comparison of ancient Chinese anatomical charts with the "Fünfbilderserie" of Sudhoff, and "The Ta Sheng Pien, a Chinese household manual of obstetrics."

(2) With the evident object of adapting the teaching in the college to the special needs of the students, other workers have made detailed studies of the methods of pedagogy now in vogue in the medical sciences in schools under Chinese and Japanese control. Information of this kind will be found under: "Health education in schools of higher learning in China," "Anatomy in China," "Anatomy in Japan," "Hospitals in Japan," "Japanese influence in Chinese medical education."

These papers show how very praiseworthy and successful have been the attempts of Chinese and Japanese educators. It is to be regretted that none of the Chinese members of the staff have themselves written independently along these lines. They are by nature very courteous and slow to come forward and to express their opinions, but they should be urged to do so, and adverse criticism should be received with special favor, because without it how can foreigners hope to fulfil their educational mission in China?

Broadminded as this attitude of the members of the staff must seem to be in regard to their special mission as teachers, the reviewer is surprised to notice the absence of any papers dealing with the normal psychology of Orientals, because it seems clear that even from a purely utilitarian point of view a consistent advance in this direction by one versed in the science of psychology would be beneficial not only as a guide in teaching but also in the interpretation of abnormal mental states. The same may be said in regard to philosophy. If Chinese efforts throughout the ages to interpret natural phenomena remain a closed book, how can the methods of western science be presented in their proper perspective?

(3) Fortunately, from a slightly different angle—that is to say, from the standpoint of anthropology—many papers bear witness to a desire for scientific information of a fundamental character regarding the Chinese as a race. Here "the physiological and anatomical norms of the Asiatic" referred to by the director are under discussion, and a fruitful attempt is commenced to push back or rather to base the investigation upon a sound knowledge of the prenatal stages of development. It will readily be seen that information of this kind is prerequisite to the intelligent interpretation of disease and to the initiation of measures of public hygiene.

Another contribution to human welfare that the Peking Union Medical College is qualified to make in the years to come lies also in the sphere of physical anthropology. In the inevitable adjustment between Orientals and Occidentals scientific information regarding the inherent capacities of the Chinese and of the effects of climatic changes and of interbreeding with other races will be of great value, supplemented, it is hoped, by a sympathetic understanding of their psychology and philosophy of life. The following papers represent a beginning in this direction: "A collection of Chinese embryos," "The anthropology of Asiatic peoples," "Concerning anthropometry and observations on healthy subjects," "Some vital statistics, based on a study of 4,000 Chinese family histories," "On an anomalous digastric muscle in the thigh of a Chinese," "The significance of certain endocranial markings in man and the importance of endocranial anatomy from the standpoint of anthropology."

(4) It is refreshing to observe that the foreign members of the staff approach their duties without dogmatism, as seekers ready and eager to learn of the real discoveries which they believe that the Chinese have already made unaided. This is particularly evident in the case of papers dealing with the Chinese materia medica. Indeed, the efforts in this regard are among the most systematic and careful that have ever been made. Certainly never before has the opportunity been so great, involving as it

clearly does close and friendly cooperation between both Chinese and foreigners, the advice of specialists in many branches of medicine, adequate facilities and a systematic program apparently extending over a sufficient period to be effective. Reference in this connection should be made to: "Botanical, chemical and pharmacological reference list to Chinese materia medica," "Toxicology in China," "A new viewpoint in pharmacology."

(5) The members of the staff have labored to fulfil the wishes of the trustees in regard to problems peculiar to the Far East, so that the bulk of the contributions fall under this heading. These problems are, however, so insistent and replete with human interest that no special stimulus was needed. What, for instance, can be of more pressing importance to residents in China than the detailed chemical information regarding Chinese foods with data concerning the distribution of vitamines, supplemented by studies on the communicable diseases of domestic servants and investigations into the health of missionary families, all of which are to be found in these volumes? Special diseases such as plague, trachoma and kala-azar have also been attacked, the latter very systematically, and the unique opportunities for the study of parasitology have been comprehensively exploited. From the many reports the following may be selected as typical: "The etiology of the last cholera epidemic," "Mastoiditis in Peking," "Filariasis in China," "The prevalence of syphilis in Peking," "Causes of blindness among the Chinese," "Osteomalacia in China," "Bronchospirochetosis in China," "Incidence of abdominal diseases among Chinese."

(6) Encouragement of research in this special field of oriental and tropical medicine is fully justified from the opportunistic point of view and in consideration of the chief purpose of the organization. But when inclination and official sanction point in the same direction, it is possible that a slight tendency to overbalance may develop, although no evidence of such a tendency is to be found in the volumes under review. Evidently a group of specialists in the medical sciences must include some men and women who, by virtue of their special training and inclinations, are not qualified to study problems thus restricted. It is obviously their duty to attack with equal enthusiasm the fundamental problems of anatomy, physiology and pathology, and of medicine and surgery, the solutions of which are of vital importance to mankind everywhere, to the nations of the west as well as to those of the east. It is with pleasure, therefore, that the reader will find many contributions of this type emanating both from the preclinical and the clinical departments. Space permits reference to a few only, which are, however, indicative of the ground covered: "Studies of gas and electrolyte equilibria in the blood," "Experiments on the hyperplasia of nerve centers," "Studies on experimental tetany," "The motor nuclei of the cerebral nerves in phylogeny," "Experiments on the production of specific antisera for infections of unknown cause," "Problems in the diagnosis and treatment of injuries to the peripheral nerves."

But biology, chemistry and physics, considered as pure sciences apart from their direct application to medical problems, are wholly without representation, although active research in these subjects would exercise a very helpful influence. Indeed, it is frequently emphasized that one of the most highly prized assets of the newly organized medical school of the University of Chicago is its close association with well-developed and very productive departments of biology, chemistry and physics, and other instances of this arrangement might be cited. When the Peking Union Medical College was reorganized, provision hitherto unsurpassed in China was made for teaching in these subjects, on the understanding that instruction would be discontinued as soon as the other schools and colleges became able (with the generous assistance of the China Medical Board) to care for high-grade premedical education. This discontinuation is even now in process of realization, with the result that the basic sciences of biology, chemistry and physics, in which active research was difficult owing to impermanency and emphasis upon teaching, are being dropped from the curriculum of the college. In this way a desirable element of university atmosphere is being lost, which is partly but not wholly compensated for by the activity in the preclinical subjects of anatomy, physiology and pathology, mentioned in the foregoing paragraphs.

In his book, "Medical Education, a Comparative Study," Abraham Flexner remarks that medical science (throughout the world) "profited enormously by the accident that in Germany it started not in a hospital but in a university in which research was as prominent as instruction." At this critical period in China, when educational ventures are being launched in all the important centers of the republic, it is desirable that a similar tendency be initiated in favor of university medical schools as contrasted with professional medical colleges. But the reverse seems to be the case, and Chinese medical education appears to be developing chiefly upon the basis of more or less well-equipped hospitals. Indeed, it is doubtful if there exists anywhere in China a medical school which is an outgrowth of a university in which research is actually as prominent as instruction. It

is interesting to note that the Japanese have, on the other hand, followed the example set by Germany and that their remarkable success in the introduction of western medicine is to be attributed, in no small measure, to the continued influence of the Imperial University Medical Schools on premedical education and especially upon research in the sciences fundamental to medicine.

In concluding this review, attention may be called to a noteworthy feature of the contributions, namely, to the cooperation of foreigners and Chinese. Long may this friendly association continue! In the four volumes under consideration, which represent the initial achievements of the enterprise (so far as they have been published), it is naturally chiefly a matter of the teacher working side by side with his Chinese student, although some of the more mature Chinese have already made important discoveries alone. Let us hope that in the years to come the tendency to work together, once happily initiated, will continue. The reviewer confidently believes that when experienced and fully trained Chinese and foreigners will join hands in united effort, fortified as they are by their peculiar heritages and intellectual endowments, a new force will be brought into medicine, and that mysteries will give way which have long baffled the best minds of England, France and Germany, indeed of all the nations of the west, laboring alone. That this new combination should act in one of the greatest of oriental cities, in an environment rich in intellectual and artistic achievement and altogether different in character from that which has fostered the advancement of science along certain lines in the west, is another factor which may be productive of surprising results. The future is full of promise, and there is a chance that the Peking Union Medical College may contribute, as few other institutions are privileged to do, toward the purpose of the Rockefeller Foundation, namely, "the welfare of mankind throughout the world."

E. V. COWDRY

THE ROCKEFELLER INSTITUTE

SPECIAL ARTICLES

EFFECT OF FREEZING AND THAWING ON THE BACTERIOPHAGE[1]

GENERALLY speaking, there are two conceptions as to the nature of the bacteriophage: (1) a living organism and (2) an enzyme. Its transmissibility in series favors the former view, while its "growth" curve and certain of its described physical and chemical properties would appear to class it among the latter.

Temperatures at or slightly below the freezing point are stated to be uninjurious to this lytic substance, but so far as the writer has been able to determine, the effect of repeated freezing-thawing has not been studied.

A bacteriophage active for *Staph. muscae* (Glaser), and another lytic for a human strain of *Bact. coli* were used. Heating at 60° C. for forty-five minutes inactivated the former, whereas the latter was only partially destroyed at this temperature. Using standardized procedures, the lytic titers of the two were very constant.

One cc quantities of the phages were frozen in small, sterile, cotton-plugged tubes on a freezing microtome with CO_2 gas. The cap of the freezing box was first unscrewed and the gas outlet covered with a piece of wire gauze to prevent the small tubes from resting in it. Over the small tubes was inverted a large test-tube, four and one half inches by one and one quarter inches, with a hole in the bottom of sufficient size to permit the escape of gas. CO_2 freely expanding in this chamber quickly lowered the temperature to a point where solid CO_2 was produced, approximately $-78°$ C.

The two phages were frozen and rapidly thawed ten, fifteen and twenty successive times, yet when titrated the titers never varied from those of non-frozen portions run as controls. Even when diluted ten thousand times with bouillon and then subjected to the freezing process for fifteen times no deleterious effect was to be noted on the staphylococcus phage.

By way of contrast, the following figures are given, indicating the numbers of a twenty-four hour old bouillon culture of *Bact. coli* which failed to survive after the first, tenth and fifteenth freezing, respectively: 16 per cent., 86 per cent., 94 per cent.

The results would indicate the bacteriophage to be something other than a viable organism, unless it constitutes an exception to the generally accepted rule that repeated freezing-thawing is injurious to living cells.

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THE RELATION OF MOISTURE CONTENTS OF WOOD TO ITS DECAY

EARLY in 1920, the senior writer began a comprehensive study of the relation of the moisture contents—or air-moisture balance—of wood to its decay and of woody plants to disease. During the past two years, the junior writers have been engaged in working out certain phases of both problems in collaboration with the senior writer.

One article, based on some preliminary experiments, was published,[1] but the publication of subsequent results has been put off from year to year to await more repetitions and more complete results. There are many difficulties in the way of satisfactorily completing such experiments, at least as they have been conducted up to the present. In the first place, the experiments are allowed to run for a year. Therefore, the maintenance of the proper moisture conditions over that period presents somewhat of a problem, not only to prevent drying out of the atmosphere, but to prevent wetting of the test blocks. For example, in the senior writer's absence one summer, the moist chamber dried out. Another summer, it was found that occasional changes in the temperature in the room caused precipitation of moisture in the jars in a large moist chamber to such extent that some of the test blocks took up water from the accumulation below.

The last series of tests, which has just been completed, was very satisfactory in bringing forward new data and in filling in some of the gaps of former series. Enough data are at hand for a fairly complete, although perhaps not a final, article on this work. Inasmuch as it would take some time under the present conditions for the completion of such an article, however, and further as it seems desirable to run some additional series, this present note is prepared to state the results thus far obtained.

Without going into details as to methods, the general idea is the following: to add definite percentages of water, from the fiber saturation point on, to oven-dried blocks of three specific gravities—Sitka spruce sp.gr. .34, southern yellow pine sapwood sp.gr. .44, and Douglas fir sp.gr. .57; to handle these in such ways as to prevent contamination by molds and place them in sterilized jars under proper conditions for growth of the fungi and maintenance of the initial moisture contents, without sterilizing the blocks themselves; to inoculate each block and the feeder with the proper fungus; and finally to plug the jars and place them away in a large moist chamber for incubation for one year. It will be noted that while sterilization is resorted to wherever possible, the blocks themselves were not sterilized, for this would change the moisture contents of the blocks. Therefore a different technique which involved every other detail of aseptic practice possible was utilized, and it is surprising how little contamination has taken place. The fungi used were the six upon which the senior writer has spent considerable time with regard to the destructon of cotton mill roofs and kindred matters: *Lenzites sepiaria, L. trabea, Trametes serialis, T. carnea, Fomes roseus* and *Lentinus lepideus.*

The purpose of the experiments was threefold: first, to obtain some general data upon the relation of the air-moisture balance to the decay of a common light wood like spruce, with particular relation to the practical problems involved in such things as the decay of mill roofs, wood preservation, the spraying of pulp log piles to prevent fire loss, etc.; secondly, to compare the air-moisture requirements or moisture inhibition points of these six and perhaps other fungi, because, for example, *Lenzites sepiaria* is a xerophyte, and *Fomes roseus* and *Trametes carnea* show certain different predilections, especially with regard to fruiting at least; thirdly, to correlate this matter of moisture and air content and decay to specific gravity of the wood decayed.

With respect to the second of the above, the experiments are not yet sufficiently complete to draw definite conclusions. Without going into details as to individual fungi, the results are given in Table I.

TABLE I

	Upper limit of optimum growth	Inhibition point of decay
Sitka spruce sp. gr. .34	150 per cent.[2]	200 per cent.
Southern pine sap sp. gr. .44	110 per cent.	160 per cent.
Douglas fir sp. gr. .57	80 per cent.	125 per cent.

The figures are of course only approximations, because exact figures in such experiments would be impossible, but, on the other hand, it is remarkable how the figures for the different fungi in many different tests agree. The above figures are in no sense averages of widely varying water per cents.

It will be noted that the results bear out in detail those of the first preliminary experiments of an entirely different type (1). It will be noted further that they agree quite closely with Muench's results upon the sapstain fungus, *Ceratostomella coerulea.*[3] In general, the decay taking place at moisture contents from the fiber saturation point of the wood up to a falling-off point is about the same, although with some of the fungi there is a tendency to greater decay at moisture percentages higher than the fiber saturation point. But the difference is such as to be of no importance in the matter of the decay of wood, for the 20 per cent. loss of oven dry weight at fiber saturation point by *Lentinus lepideus* is just as much

[1] Walter H. Snell, "Relation of moisture contents of wood to its decay," *Paper Trade Journal,* 71, 28: 44–46, 1921; also in *Paper,* May 4, 1921.

[2] Figures refer to percentage of water based upon oven dry weight of the wood.

[3] Muench, E., "Untersuchungen über Immunität und Krankheitsempfänglichkeit der Holpflanzen," *Zeitschr. f. Forst. und Landw.* 7: 54–75, 87–114, 120–160, 1909.

destruction of the wood as is 40 per cent. loss at 60 per cent. or 80 per cent. moisture content.

The maximum moisture content at which decay can take place in any of our commercial woods is about 190 per cent. or 200 per cent. Beyond that point, the water drives out so much of the air that insufficient is left to support growth of these wood destroyers.

The relation of this problem to specific gravity is obvious, of course. Presupposing that a certain definite volume of air is necessary to support the growth of these wood destroyers, the moisture content favoring the maximum amount of decay or inhibiting decay entirely will vary inversely with the specific gravity. The incomplete series show that satisfactorily. With woods of three specific gravities, there have been obtained three points for both the limit of optimum decay and the inhibition point in terms of percentage of water. It can not of course be determined as yet whether these points form a straight line on the graph or are on a parabolic curve. Tests are now in progress not only to fill the gaps existing in the present series, but also to obtain two more points in the graph by growing certain of the fungi upon southern yellow pine of specific gravities .65 and .75. Whether these points will then form a straight line or a curve, it is expected to be able to prove that the durability of some of our heavy woods, like white oak and best southern pine, etc., is not due to tannin, resin or anything more than its high specific gravity—*i.e.*, its small lumina, and hence small amount of air available for fungous growth.

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THE AMERICAN MATHEMATICAL SOCIETY

THE thirty-first summer meeting and tenth colloquium of the American Mathematical Society were held at Cornell University, from September 8 to 12, 1925, in connection with the meeting of the Mathematical Association of America. The attendance included one hundred and forty-nine members of the society, a record for a summer meeting.

The attending mathematicians and their guests were very hospitably entertained at Sage College, on the beautiful university campus. Many enjoyable social events were arranged by the mathematics department of the university, including a reception at which President Farrand welcomed the visitors. The joint dinner of the two mathematical organizations, with Professor H. E. Slaught as toastmaster, was attended by one hundred and eighty-five persons. A hearty vote of thanks was passed to the local members of the committee on arrangements, Professors Tanner, Gillespie and Hurwitz.

The secretary reported the appointment of the following committee on nominations of officers and members of the council and board of trustees for 1926: W. B. Ford, Robert Henderson, D. N. Lehmer, E. J. Townsend and Oswald Veblen (chairman). Professor Harris Hancock was appointed to represent the society at the celebration of the semi-centennial of Vanderbilt University. The council adopted a resolution of thanks to the assistant secretary, Professor Arnold Dresden, for his able and devoted service in carrying on the additional duties of the secretary during the six months' absence of the latter in Europe.

It was announced that the next volume of the *Bulletin of the American Mathematical Society* will be printed by the George Banta Publishing Company, at Menasha, Wisconsin.

Invitations from Hunter College for the next annual meeting, from Ohio State University for the summer meeting of 1926 and from the University of Wisconsin for the summer meeting and colloquium in 1927 were accepted, with hearty thanks.

The colloquium speakers were Professors L. P. Eisenhart, of Princeton University, and Dunham Jackson, of the University of Minnesota. Each speaker delivered five lectures, which will be published by the society. The subjects were as follows:

Professor Eisenhart: *The new differential geometry.* (I) Riemannian geometry; (II) Linear connection of a space; (III) Geometry of paths; (IV) Geometry of a sub-space of a linearly connected space.

Professor Jackson: *The theory of approximation.* (I) The approximate representation of continuous functions; (II) Discontinuous functions and functions of limited variation; (III) The principle of least squares and its generalizations; (IV) Interpolation; (V) The geometry of function space.

The following papers were read at the regular sessions of the society:

Space involutions having a web of invariant rational surfaces: F. R. SHARPE.

Note on six points in a plane and the six conics determined by them: W. B. CARVER.

On the reality of singularities of plane curves: T. R. HOLLCROFT.

Self-projective plane 5-points: LOUIS WEISNER.

Plane cubic curves in the Galois fields of order 2^n: A. D. CAMPBELL.

Generalization of certain theorems of Bohl. Second paper: F. H. MURRAY.

Ricci notation for geometrical products: C. L. E. MOORE.

Projection of a fixed vector on a surface: G. Y. RAINICH.

Mass in curved space-time: G. Y. RAINICH.

Mutually consistent regression surfaces for three-dimensional frequency solids: B. H. CAMP.

New properties of an orthocentric system of triangles: A. A. BENNETT.

Solutions of the Einstein equations for empty space: H. W. BRINKMANN.

Einsteinian 4-spaces imbedded in euclidean 5-space: H. W. BRINKMANN.

Riemann spaces of class one: H. W. BRINKMANN.

The torsion of a Riemannian n-space imbedded in a euclidean m-space ($m \leqq n+2$)*:* H. W. BRINKMANN.

Solution of the problem of the thick rectangular plate with two opposite edges supported and two edges free, and under uniform or central load: C. A. GARABEDIAN.

Rectangular plates of constant or variable thickness: C. A. GARABEDIAN.

A generalization of the tetrahedral complex in odd S_{n-1}*. Preliminary report:* J. A. EIESLAND.

The loci of point singularities on a generalized Kummer surface in odd S_{n-1}*:* J. A. EIESLAND.

Note on rational plane cubics: C. A. NELSON.

A projective theory of affinely connected manifolds: T. Y. THOMAS.

A study of the conformal mapping $w = az + b/z + c/z^2$ *and its application to aerodynamics:* F. D. MURNAGHAN.

On the use of fractions in the algebra of logic: A. D. CAMPBELL.

Concerning the relation between separability and the proposition that every uncountable point set has a limit point: R. L. MOORE.

Concerning the separation of point sets by curves: R. L. MOORE.

The double elliptic case of the Lie-Riemann-Helmholtz problem of the foundations of geometry: R. G. LUBBEN.

Concerning limiting sets: R. G. LUBBEN.

Surrounding theorems with applications to questions of accessibility: R. G. LUBBEN.

Taylor's theorem in general analysis: L. M. GRAVES.

On the oscillation of a continuum: W. A. WILSON.

Some properties of a continuum limited and irreducible between two points: W. A. WILSON.

A proof of Weierstrass's theorem, with applications to Dirichlet's principle: E. R. HEDRICK and M. B. PORTER.

On a generalization of Gibbs' phenomenon: E. R. HEDRICK and M. B. PORTER.

A problem in the calculus of variations with an infinite number of auxiliary conditions: R. G. D. RICHARDSON.

On convergence factors in multiple series: C. N. MOORE.

Relations between the singular points of n ordinary differential equations of the first order: MARSTON MORSE.

A class of reciprocal functions: EINAR HILLE.

Boundary problems and expansion theorems in the theory of integro-differential equations: JACQUES TAMARKIN.

Second law of the mean in the theory of definite integrals: JACQUES TAMARKIN and C. E. WILDER.

On a general formula in the theory of Tchebycheff's polynomials and its applications: J. A. SHOHAT.

Note on a fundamental theorem concerning the limit of a sum: H. J. ETTLINGER.

On the conditions of integrability of covariant differential equations: J. A. SCHOUTEN.

The fundamental region for a Fuchsian group: L. R. FORD.

On the form of the solid of revolution of minimum resistance when the normal resistance varies as the nth power ($n > 0$) *of the normal velocity:* R. P. AGNEW.

Some properties of bounded polynomials in several variables: O. D. KELLOGG.

Simplification of a general method of summability of divergent series: L. L. SMAIL.

Multiply transitive substitution groups: G. A. MILLER.

A program on ordinary differential parameters. Preliminary report: O. E. GLENN.

Groups in which the normalizer of every element is abelian: LOUIS WEISNER.

On the formal modular invariants of binary forms: W. L. G. WILLIAMS.

Application of the theory of relative cyclic fields to both cases of Fermat's last theorem: H. S. VANDIVER.

On algorisms for the solution of the quadratic congruence: H. S. VANDIVER.

Laws of reciprocity and the first case of Fermat's last theorem: H. S. VANDIVER.

A new theory of the representation of integers as definite quadratic forms: H. S. VANDIVER.

Note on the condition that a cubic equation have an integral root: H. S. VANDIVER.

Definite linear dependence: L. L. DINES.

On certain symmetric sums of determinants: L. L. DINES.

Proof that large primes have four consecutive quadratic residues: A. A. BENNETT.

The algebraic structure of the formulas in plane trigonometry. Second paper: T. H. GRONWALL.

An algebra of sequences of functions: E. T. BELL.

The next meeting of the society will be in New York City on October 31; the San Francisco section will also meet at Berkeley on the same date. The western Christmas meeting will be held at Kansas City, in conjunction with the meetings of the Southwestern Section and with the American Association for the Advancement of Science. The annual meeting will be held at Hunter College, New York City, on January 1 and 2, 1926.

R. G. D. RICHARDSON,
Secretary.

BROWN UNIVERSITY